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Title: Unattended Dual Current Monitor (UDCM) Unattended Multiplicity Shift Register (UMSR) FY18 Summary Report

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Unattended Dual Current Monitor (UDCM) Unattended Multiplicity Shift Register (UMSR) FY18 Summary Report

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Summary

This fiscal year LANL was funded to modify both the UDCM and UMSR based on the IAEA recommendations from their Initial Evaluation of the Unattended Dual Current Monitor (UDCM) report, SG-RP-14384 and the December 2017 meeting at the Agency. Modifications include increasing the instruments sensitivity range, including a remote reset function, modifications to the web interface and modifications to the firmware for improved usability. The final product will be an updated UDCM and UMSR that are ready for commercialization. This report describes that work.

Description

The scope of work for the modifications addressed this year is outlined below:

1. Increase the measurement range. Lower range by a factor of 5 and upper range by 2 orders of magnitude.
2. Increase programmable acquisition time to 3600s
3. Develop a method to handle current offsets and negative current.
4. Error checking when writing data to the uSD card.
5. Writing BID files along with the currently stored BIO files.
6. Develop and implement a remote reset technique
7. Add a secondary storage uSD card and boot the instrument from flash.
8. Modify firmware to store instrument State-of-Health, SOH, information.
9. Add a fourth input to the UMSR and allow a 50 ohm input option
10. Modify shift register to allow for a 0ns predelay.

Increasing the measurement range of the UDCM required a third gain range and a redesign of the input circuitry. A new board that mounts to the main UDCM board was designed. This new board not only increased the measurement range but also utilized new parts and eliminated old parts that were near their end of life. This significantly improved the overall expected lifetime of the UDCM by removing parts that were close to obsolescence. The new input design has been tested and the new measurement range easily spans the IAEA's requested range. The new input circuitry allows for input currents of opposite polarity to handle current offsets and negative currents.

Adding a second uSD card for backup data storage and a second boot disk for robustness was also successfully accomplished in FY18. The second uSD card is located inside the UDCM and UMSR and is not physically accessible by the user. This second uSD card is used to store duplicate data and a second operating system. The UDCM and the UMSR now perform error checks during the boot process and if the operating system is corrupt on the main disk the units will boot from the second uSD card. This adds significant robustness to the systems. Data stored on both the uSD cards are also stored with a CRC code for checking for data integrity.

The instrument users can now check the data to ensure that the data is correct and not corrupted. If the main data is corrupt the user can then retrieve the backup data from the internal uSD card.

UMSR firmware was modified to allow the user to set the predelay to a minimum of 0 seconds. Previous versions of shift register predelays could only be set to a minimum of two clock cycles due to the counter reset circuitry. Count times for both the UMSR and UDCM were increased from the maximum of 1000s seconds to 400M seconds. BID and BIO files are now being stored for the UDCM results. State of health information is stored in the syslog and in the log files directory on the uSD cards. New temperature, humidity and power monitors were added to both instruments.

Hardware modifications included adding a fourth input channel on the UMSR based on the IAEA's request. The inputs are also 50 ohm input impedance selectable. We modified the circuit board size to allow the circuit board to be mounted into Euro-rack sized electronics enclosures for rack mountability. The new versions of UDCM and UMSR are fully compatible with PXI bus chassis enabling the instruments to be either standalone or rack mounted.

Conclusion

All changes are currently being tested and the new prototypes with new firmware should be ready to send to the IAEA by the end of October 2018. IAEA experts, Thierry Pochet and Martin Frankl, visited LANL to see a spent fuel monitoring instrument during the week of Sept 24th. During that visit they spent some time reviewing the status of the UMSR and UDCM instrument development. The feedback from Martin and Thierry was very positive and they are both interested in getting commercial supplied instruments for their UMS systems.

Future Work

Fully tested prototypes will be shipped to the IAEA next month for their evaluation. Drawing packages will be assembled and finalized for preparation for commercialization. FY19 work will include completing the user manuals and adding an auto-ranging function to the UDCM. Presentation of the UDCM and UMSR designs will be given at next year's INMM.